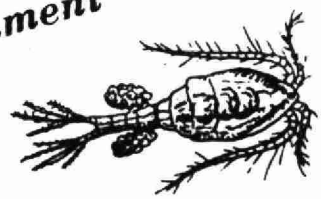
FACTS

FOR ENVIRONMENTAL STUDIES

Investigating Your Environment



Ontario
Ministry of the Environment

Hon. George A. Kerr, Q.C.
Minister

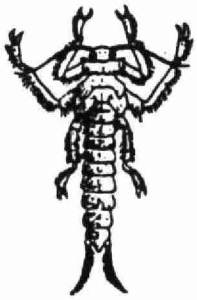
K. H. Sharpe
Deputy Minister

A LESSON PLAN FOR MEASURING SOME WATER QUALITY CRITERIA

Set the stage for this investigation by reviewing quickly what will take place in the allotted time. For example: In the next 4 hours we will investigate evidences of aquatic life in this stream, infer stream temperature, O_2 and pH from that life, and then check out our inferences through experimentation. We'll determine the streamflow of the stream and discuss ecological, social, and political concerns of using such water. You might want to read the behavioral objectives which appear at end of this lesson plan and refer back to them as an evaluation of the session.

I. DETERMINING WATERSHED BOUNDARIES

Distribute maps of the area, 1 for every person.

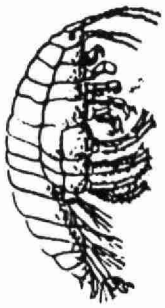


TASK A: (15 minutes) Work in small groups.

Find _____ Creek on the map. Find your location.
Where does the water in this stream come from? Trace upstream to its source.
Draw lines around the boundaries of our watershed. We're in the _____ Creek watershed.

II. OBSERVING THE STREAM ENVIRONMENT

Assign Task B, for recording observations of the stream environment. Walk to stream. Distribute Task B cards.



TASK B: (10–15 minutes) Work by yourself or in small groups.

As you approach the stream, observe and record your observations about the stream environment: (Can be done visually and verbally.)

plants _____

animals _____

air _____

rocks _____

water _____

Questions and discussion:

1. What did you notice about the stream environment?
2. What plants were growing on the gravel bar?
3. Why aren't large trees growing on the gravel bar?
4. What did you notice about the rocks?
5. Where did you see the bigger rocks? the smaller?

III. OBSERVING AQUATIC ANIMALS

Questions and discussion:

1. What did you notice about the water in the stream?
2. What do animals need to live in water?
3. Where would you expect to find animals in the water?
4. What guidelines need to be developed by our group as we collect animals from the stream? Discuss what to do with animals kept for observation, what to do with rocks that are overturned, what to do with animals when the session is over.

Distribute Task C cards.

TASK C: (30–40 minutes) Work by yourself or in groups.

Using collecting equipment (screens, jelly cups, etc.) collect as many types of aquatic animals as possible. Put them in the white containers for observation by the group. (Keep the pan in a cool place.)
Contact the instructor when you're finished, to receive the next task.

Note to instructor: Go from group to group to see how they're doing.

IV. IDENTIFYING AND RECORDING AQUATIC ANIMALS

Distribute Task D cards.

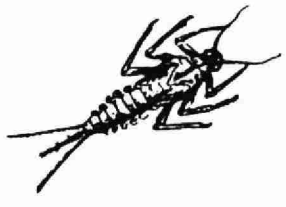
TASK D: (20–30 minutes) Work by yourself or in groups.

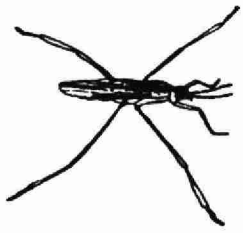
Using the "Golden Nature Guide Pond Life" books or similar field manuals and attached picture keys, generally identify the specimens you found.

List or sketch the animals you found below.

Description of where found	*Type (name or sketch)*	*No.*

Return animals to water as soon as finished.





Questions and discussion:

1. What animals did you find?
   Compile a group list, (preferably on a chart). Each person should record the group list on his own work sheet, (Task D).
2. Where did you find most of the specimens?
3. What similarities are there among the specimens?
4. What differences did you find?
5. What classification system could we use to classify the aquatic animals we found?
6. What other life would you expect to find in this stream?
7. Would we be likely to find the same specimens in a different aquatic environment? Why or why not?

V. PREDICTING WATER CHARACTERISTICS FROM AQUATIC ANIMALS FOUND

What were the things we said animals needed in order to live in the water?
(Review earlier discussion.)

Assign the following task:

Distribute Task E cards.

TASK E: (15–20 minutes) Work by yourself.

Based on the aquatic animals you found, and the charts below in the Analyzing Data section, predict the following characteristics of this stream:

I predict:

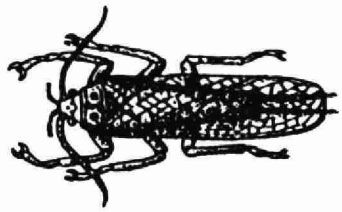
the water temperature will be _____ because _____
the air temperature will be _____ because _____
the pH number will be _____ because _____
the dissolved O_2 count will be _____ because _____

Keep these predictions for your own reference.

ANALYZING DATA

pH RANGES THAT SUPPORT AQUATIC LIFE

	MOST ACID					NEUTRAL							MOST ALKALINE	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Bacteria	1.0												13.0	
Plants (algae, rooted, etc.)						6.5						12.0		
Carp, suckers, catfish, some insects						6.0			9.0					
Bass, crappie						6.5		8.5						
Snails, clams, mussels							7.0		9.0					
Largest variety of animals (trout, mayfly, stonefly, caddisfly)						6.5	7.5							



DISSOLVED OXYGEN REQUIREMENTS FOR NATIVE FISH AND OTHER AQUATIC LIFE

	D.O. in parts per million
Cold-Water Organisms including (salmon and trout)(below 68°)	
Spawning	7 ppm and above
Growth and well-being	6 ppm and above
Warm-Water Organisms (including game fish such as bass, crappie)(above 68°)	
Growth and well-being	5 ppm and above

TEMPERATURE RANGES (APPROXIMATE) REQUIRED FOR GROWTH OF CERTAIN ORGANISMS

Temperature		*Examples of life*
Greater than 68°. (warm water)		Much plant life, many fish diseases. Most bass, crappie, bluegill, carp, catfish, caddisfly.
Less than 68° (cold water)	Upper range (55–68°)	Some plant life, some fish diseases. Salmon, trout, Stonefly, mayfly, caddisfly, water beetles, striders
	Lower range (Less than 55°)	Trout, caddisfly, stonefly, mayfly

Questions and discussion:

1. As a group, discuss the range of predictions.
2. What criteria did you use to arrive at your predictions?
3. How can we test out our predictions?

VI. MEASURING AND RECORDING WATER CHARACTERISTICS TO TEST OUT PREDICTIONS

Directions to group:

We can test out the predictions we just made, using these kits (Hach O_2 pH Testing Kit or equivalent) Open up kit. Mention that instructions are inside lid.

There are lots of jobs to be done in testing (clipping, squirting, swirling, dipping, counting, reading, etc.) so make sure everyone in the group has a job to do.

Work in groups of 5-6 people each. Each group take a kit. Send groups to different parts of the stream.

Note to instructor: It is not necessary to demonstrate the use of the kit. Let the students do it. Task F could be taped somewhere on the water test kit.

Distribute Task F cards.

TASK F: (20–30 minutes) Work in groups of 4–6 people.

MAKE SURE EVERYONE IN THE GROUP GETS INVOLVED IN THE TESTING.

Using the water test kit, determine the water temperature, air temperature, dissolved oxygen count, and pH of the stream.

Record the data below: Also record predictions from Task E to compare.

Location of water sample (edge or middle of stream)	*Time taken*	*Temperature*				*pH*		*Usable oxygen (ppm)*	
		Water		*Air*					
		My prediction	*Actual test*	*My prediction*	*Actual test*	*My prediction*	*Actual test*	*My prediction*	*Actual test*

Questions and discussion:

Have each group report the results of their tests to the entire group. Compare results.

1. What might account for any differences in results from each group?
2. How did the test results compare to the predictions?
3. Is it necessary to have sophisticated equipment to determine temperature, oxygen, pH, etc.? Inferences could be made from the animals found in the stream.
4. What can we say about the quality of the water in this stream?
5. What else would we need to know to decide whether or not to drink this water?
6. Under what conditions might we expect to get different test results than we did today?

VII. MEASURING STREAMFLOW (Use if investigation is being made along a stream.)

Distribute Task G cards.

Questions and discussion:

1. What measurements do we need to know in order to determine the amount of water in this stream? Discuss how to make different measurements. See Task G.
2. Predict how many people could live off the water in this stream._____

TASK G: (45 minutes)

DETERMINATION OF STREAMFLOW

Instructions for collecting and recording streamflow measurements.

a. Measure and mark a 100-foot distance along a straight section of your stream. If you can't find a 100′ section, use 25′ or 50′. Throw a stick (2 or 3 inches long) in the water above the upstream marker. Record the number of seconds it takes to float downstream between the markers. Record below. Now divide the 100-foot distance by the total seconds it took the stick to float between the stakes.

100 ft. ÷ _____ = _____ ft. per second
(distance) (total seconds to float 100 ft.) (number of feet stick floated each second)

b. Find the average width of your section of the stream. Measure the width of the stream at 3 places within the 100 foot area. Divide the total by 3 to get the average width of the stream.

First measurement_____feet.
Second measurement_____feet.
Third measurement_____feet.
Total_____feet ÷ 3 = _____ft. (average width)

c. Find the average depth of your section of the stream. Measure the depth of the stream in at least 3 places across the stream in a straight line. Divide the total by 3 to get the average depth of the stream.

First measurement_____feet.
Second measurement_____feet.
Third measurement_____feet.
Total_____feet ÷ 3 = _____ft. (average depth)

d. Find the cubic feet of water per second. Multiply the average width, average depth, and the number of feet the stick floated each second.

_____ft. × _____ft. × _____ = _____

Average width	Average depth	Number of feet per second	Cubic feet of water flowing per second

Note: A cubic foot of water is the water in a container 1 foot wide, 1 foot high and 1 foot long, and contains 7.48 gallons.

In order to find out how many people could live from the water in this stream, complete the following calculations.

_____ × 7.48 = _____
Stream flow in Cu. ft. per sec. | Gallons in 1 cu. ft. of water | Gallons of water per second

_____ × 60 = _____
Gallons per second | Seconds in minute | Gallons of water per minute

_____ × 1440 = _____ ÷ *200 Gals. = _____

Gallons of water per min.	No. minutes in a day	Total gallons water per day	Amount of water one person uses per day	Total No. people who could live from water in this stream

* The average person uses about 200 gallons of water a day for home use. This does not reflect each persons share of water used for industrial, public services, and commercial.

Questions and discussion:

1. How many people in a community could live off the water in this stream?
2. What would happen to this environment if we piped all the water out of the stream at this point to a community?
3. If we were going to use this water, how much water should be left to flow down stream? Why?
4. Does this stream always have this amount of water in it? Why?
5. What are some problems you encountered during this task?

VIII. COMMUNICATING FEELINGS, AWARENESS, AND VALUES ABOUT WATER

Questions and discussion:

Distribute Task H cards.

How important is this stream to us?

TASK H: (10–15 minutes) Work by yourself.

1. Describe in writing how you feel about man's effect on the aquatic environment at this site:

2. Describe at least one action you can take in your everyday life to help improve the way water is managed:

   (a) in your home:_____

   (b) in your community:_____

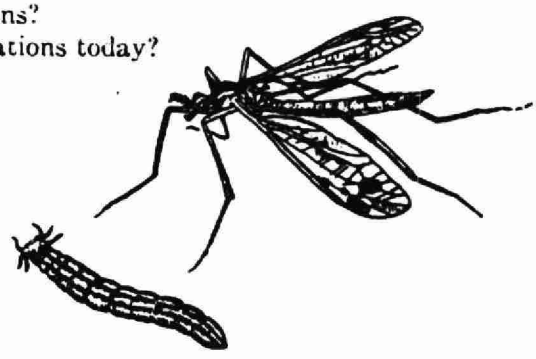
   (c) in your consumer habits:_____

3. Describe the benefits of each action in #2.

Summary Questions

1. What did you find out about water from our investigations today?
2. Why is water important to the ecosystem?
3. How can we summarize our discussions and investigations?
4. What methods and processes did we use in our investigations today?

Distribute Task I cards.



TASK I:

Describe in writing how you feel about our session today.

Behavioral Outcomes in Knowledge

As a result of this session, you should be able to:

Identify the boundaries of the_____Creek watershed on the map provided.
Predict the pH, temperature, and dissolved oxygen count of the stream, using the list of aquatic animals found and the water interpretation charts provided.
Demonstrate the ability to test out the above predictions using the water testing kit.
Measure the cubic feet of water per second flowing in the stream, and determine what size community of people could live off the water in the stream.
Describe three ways this stream is important to the surrounding environment.

Behavioral Outcomes in Feelings, Awareness, Values, and Action

As a result of this session, you should be able to:

Describe in writing how you feel about man's effect on the aquatic environment at this site.
Describe at least one action you can take in your everyday life to help improve the way water is managed:
(a) in your home
(b) in your community
(c) in your consumer habits
Describe the benefits of each of the above actions.

Equipment Needed: (for a class of 30 people)

4 water testing kits (Hach Co. or equivalent)
4 thermometers
4 white dishpans
30 sets of lab sheets
30 jelly cups
30 hand lenses
15 Pond Life books (Golden Nature Guides)
30 maps of the area
4 50′ or 100′ tapes
4 screens (optional)
magic markers
chart paper

SUB-SURFACE
FRESH WATER ORGANISMS

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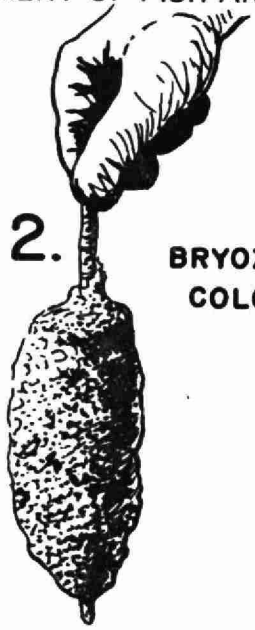
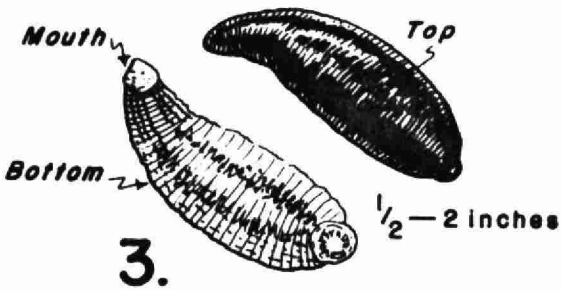
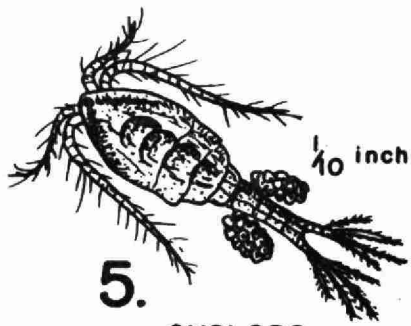
1.
PLANARIA



2.
BRYOZOAN
COLONY

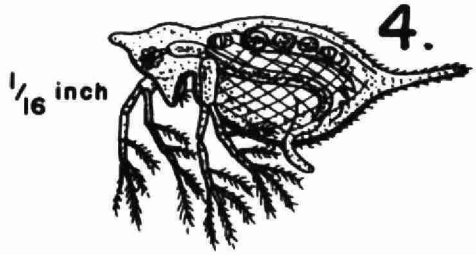


3.
LEECH



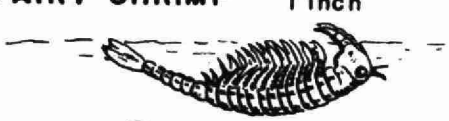
5.
CYCLOPS

DAPHNIA



4.

FAIRY SHRIMP 1 inch



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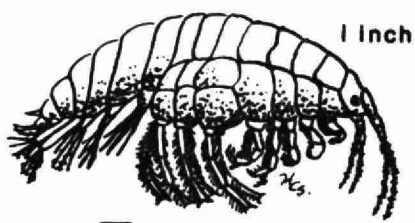

7. FRESH WATER
SHRIMP

SUBSURFACE FRESH-WATER ORGANISMS

1. Planaria (Turbellaria)

Planarians are fairly common in ponds, lakes, springs, and other fresh waters among vegetation, beneath stones, or crawling over the bottom. These free-living flatworms are usually arrow-shaped and vary in color from white to black depending on species and environment. Small planaria look much the same as the adult differing only in size.

2. Bryozoan Colony (Broyozoa)

Fresh-water Bryozoa are very common in lakes, ponds, and rivers. They are community dwellers, living in jelly type substance which is formed on sticks as a gelatinous ball or a mossy mat over the surface of underwater objects. There is a wide range in color, some colonies are brownish and still others have a greenish tinge. Colonies are made up of thousands of these tiny animals.

3. Leech (Hirudinea)

Leeches make homes in lakes, ponds, or other fresh-water areas. They can be seen moving about underwater by their well-known "Measuring Worm" type of travel, or swimming freely. Leeches are predatory or parasitic segmented worms with sucking discs which are used in attachment, movement, and feeding. They are usually dark brown to black in coloration.

4. Daphnia (Cladocera)

Daphnia are found in all sorts of fresh waters. The shallow, weedy backwaters of a lake whose water level is fairly permanent harbors greater numbers that any other kind of locality. These little crustaceans are virtually transparent, and are best recognized by their two-branched antennae, robust bodies, and sharp-tail spine.

5. Cyclops (Copepoda)

These little fresh-water crustaceans are very familiar in all slow moving waters, especially shallow ponds. Their bodies, like the Daphnia, are very transparent and are characterized by the forked antenna and the branched tail. The female usually has two groups of eggs attached to her body just ahead of the tail.

6. Fairy Shrimps (Anostraca)

For the most part, fairy shrimps live in temporary pools and ponds of fresh water. They are frequently seen underwater, rowing themselves about on their backs, by means of numerous, similar, flattened appendages. These appendages are always faced toward the source of light.

7. Fresh-Water Shrimp (Malacostraca)

These are found in lakes, streams, and ponds in eastern and western Oregon. Shrimp are usually found among the aquatic plants, rocks, and algae. Usually they are nearly transparent and look something like a "sow bug".

AQUATIC INSECTS

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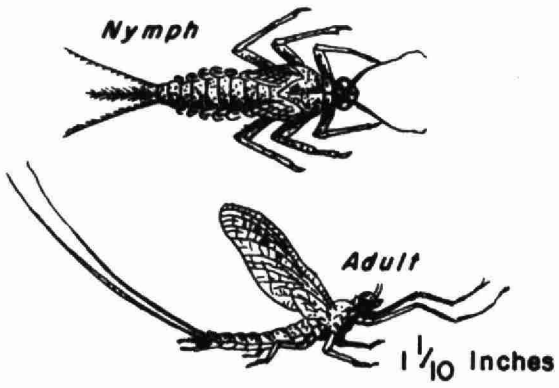
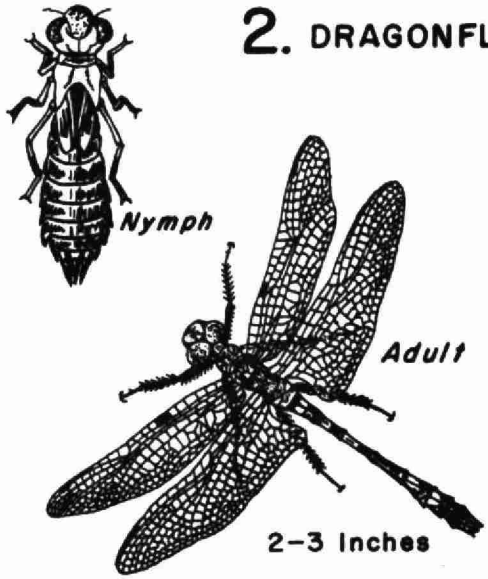
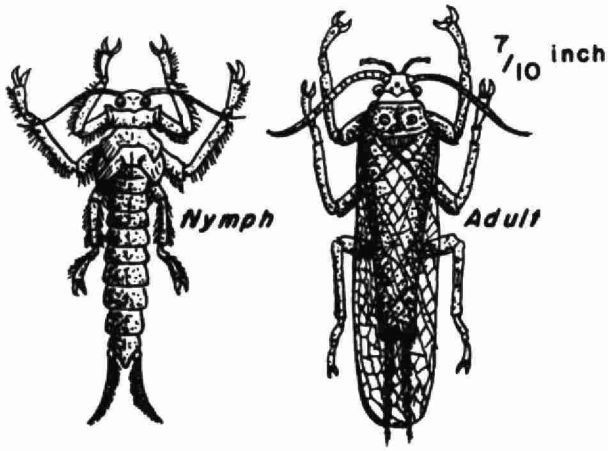


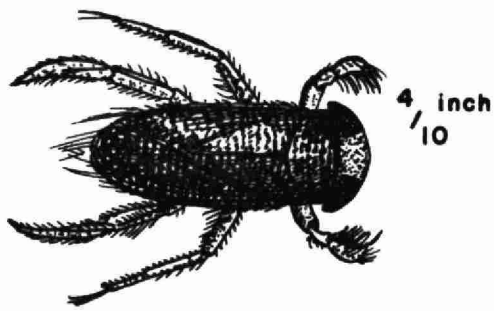
1. MAYFLY



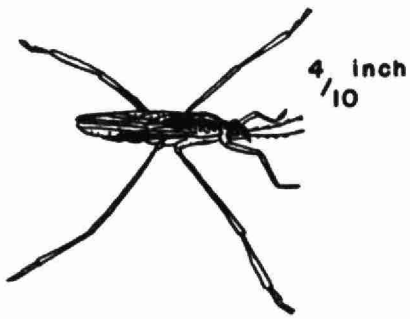
2. DRAGONFLY



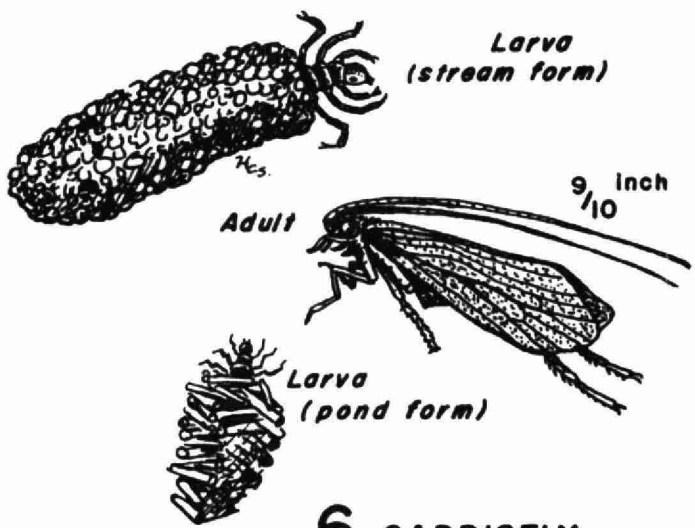
3. STONEFLY



4. WATER BOATMAN



5. WATER STRIDER



6. CADDISFLY

AQUATIC INSECTS

1. May Flies (Ephemerotera)

May flies are abundant in streams and lakes and can be found in practically all fresh water throughout the state. The nymphs are found on the undersides of rocks or other underwater objects. They have two or three tails. The wings of the adult are held in an upright position while resting.

2. Dragonfly (Odonata)

They are found in all types of fresh-water areas; ponds, lakes, streams, and swampy areas. The nymphs can be found crawling about on the bottom, on aquatic plants, or other underwater objects. They are one of the largest aquatic insects; most of them are dark brown to greenish as juveniles, change to brighter colors as adults. When resting, their four wings are held outstretched.

3. Stone Fly (Plecoptera)

Stone flies seem to require running water in which to live. They are never found in lakes except in the inlets and outlets. When the adult is resting its wings lie lengthwise upon the back. Nymphs are found in abundance only among the rocks in streams. Stone fly nymphs have two long and stiff tails.

4. Water Boatman (Hemiptera)

Boatmen are found in nearly all waters. They swim in an erratic pattern underwater, and usually found in slow moving waters. Boatmen are normally brownish in color and equipped with leathery wings.

5. Water Strider (Hemiptera)

Water striders are a familiar sight on the surface of slow moving waters, ponds, and lakes. They resemble long legged spiders. Although equipped with wings, they are rarely observed in flight. Their color is usually brown to gray. Many persons call them "water skippers".

6. Caddis Fly (Trichoptera)

Caddis flies are found in nearly all lakes, streams, and ponds. During their underwater life, they live in cases made from sticks and small particles of rock. These can usually be seen moving about on the bottom. When the adults are at rest the wings are held roof-like over the body and sloping down at the sides. The adults are generally dull brown or black in color. Sometimes the larvae are called "penny winkles" by fishermen. "Periwinkle" is another common name.

AQUATIC INSECTS

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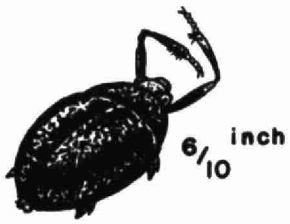
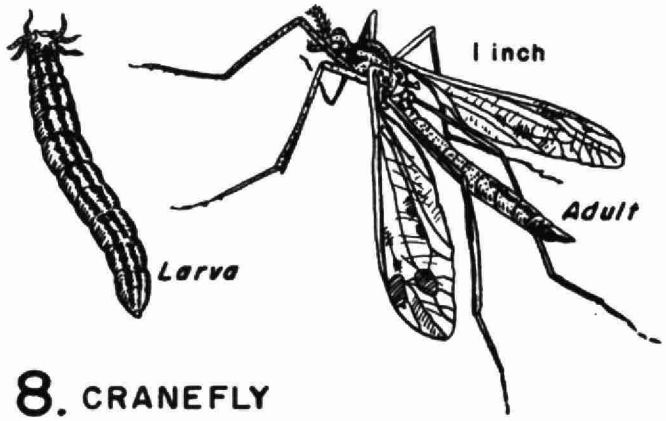
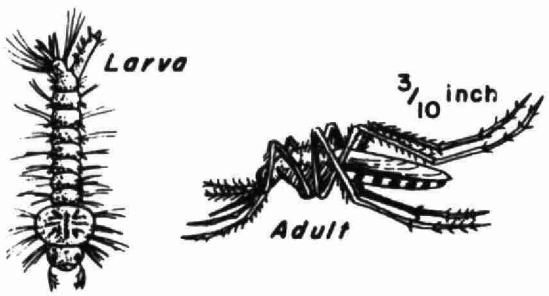


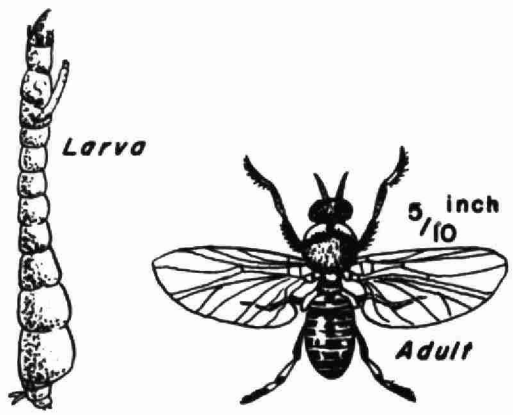
7. WHIRLIGIG BEETLE



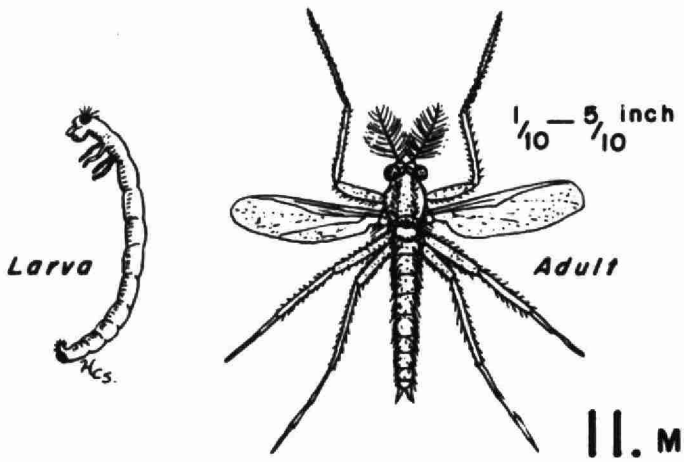
8. CRANEFLY



9. MOSQUITO



10. BLACK FLY



11. MIDGE

AQUATIC INSECTS

7. Whirligig Beetle (Coleoptera)

These are found on the surface of slow moving waters, taking advantage of the surface tension. The Whirligig beetles, true to their name, whirl or swim on the water's surface. When disturbed they dive under the water, frequently. Their bodies are dark colored, robust, and the front legs are long and slender.

8. Crane Fly (Diptera)

The larvae of the Crane fly are found in scum of shallow waters, in the damp soil along streams or lake shores, and marshy areas. The adults are never truly aquatic and may be found great distances from water. The adults look much like giant mosquitoes without a beak.

9. Mosquitoes (Diptera)

Mosquitoe larvae are usually found in stagnant slow moving water. Most people are familiar with the appearance of adults and know that they are more abundant around marshy, damp areas. The young are often called "wigglers" and can usually be found wiggling about just under the water's surface. Contrary to popular belief, not all mosquitoes bite, the males just buzz and are not equipped for biting.

10. Black Fly (Diptera)

The larvae are found in flowing water (only) on stones, vegetation, or other objects, usually in the swiftest part of the stream. In many cases, the larvae are so numerous they appear moss-like over the surface of the attached object. Later on in life, they live in a cocoon which is customarily a boot-shaped structure. The Black fly as the name implies, are usually dark compactly built flies, with rounded black and short broad wings. The adults may be found great distances from water.

11. Midges (Diptera)

Larvae are most abundant in the shallow water areas of lakes, ponds, and streams favored by a heavy growth of aquatic plants. They prefer soft mucky bottoms, as they are a bottom-dwelling species, and need this type environment for constructing their tube-like homes. Larvae live in soft tubes, however, during later stages of life they are found living in silken cocoons or gelatinous cases. The adult Midges look much the same as mosquitoes. Their antennaes look like two feathers on the front of their head and they don't have a beak.

CONDUCTING THE INVESTIGATIONS

The following guidelines may help in conducting the environmental investigations in this packet. They are not "sure fire," of course, and may require some adaptation in different situations. They take into consideration some of the stumbling blocks that can interfere with the student's fullest involvement in learning activities.

1. Minimize as fully as possible the amount of lecturing, showing, or telling.
2. Go over the objectives of the investigation, briefly, with the students so they will know what to expect.
3. Do a preview by yourself of the investigation in the place where it is to be conducted.
4. Plan and pace the session so that each task can be done thoroughly and well.
5. If there are time restrictions that prevent doing an entire investigation, decide in advance which tasks are to be omitted. Don't get trapped into rushing so much that you provide all the data verbally instead of allowing students to collect it.
6. Use the lesson plans as a guide, particularly for the questioning and discussion periods, but don't hesitate to revise as necessary once the plan has become familiar.
7. Start the summarization of the investigation at least a half hour before the time period ends. Since these summaries deal with the ways that what is learned in the investigations can be applied to land management and environmental problems, they are extremely important and should be given ample time.
8. Use the summarizations as evaluation tools. The discussion that concludes each session will reveal what concepts and understandings have been acquired by students and what additional information they may need.
9. Include a discussion of ways the investigation can be used in classrooms or on schoolgrounds, especially giving consideration to ways environmental studies can be integrated with other subject areas of the school curriculum.
10. Do a self-evaluation of the session while it is still fresh in mind so that improvements can be made for later sessions.

Moving people from place to place and having enough equipment may not be the most important things in an instructional activity; however, too little attention to these can detract from the success of the instruction, so consider the following:

1. Make sure that you have enough equipment and that it is in working order.
2. Plan for checking out and returning the equipment. It is usually best to assign a student to this job.
3. Discuss possible hazards, "rules of the road," and sanitary provisions with the students before leaving for the study area.

CONCLUSION

The ideas and activities in these teaching materials will not "come to life" until you have tried them, modified them, and improved them to fit your own needs and the location. Every teacher has a special style of his own, and he should use the lesson plans to fit that personal style.

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